Gensym 2014 Users Group Conference

Hotel Du Louvre, Place André Malraux, Paris, France

2 June 2014

ISHM G2 Toolkit

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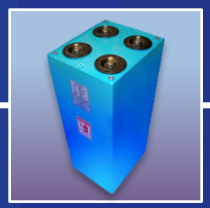




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GENERAL ATOMICS
ELECTROMAGNETICS

Overview – ISHM Toolkit
Integrated System Health Management

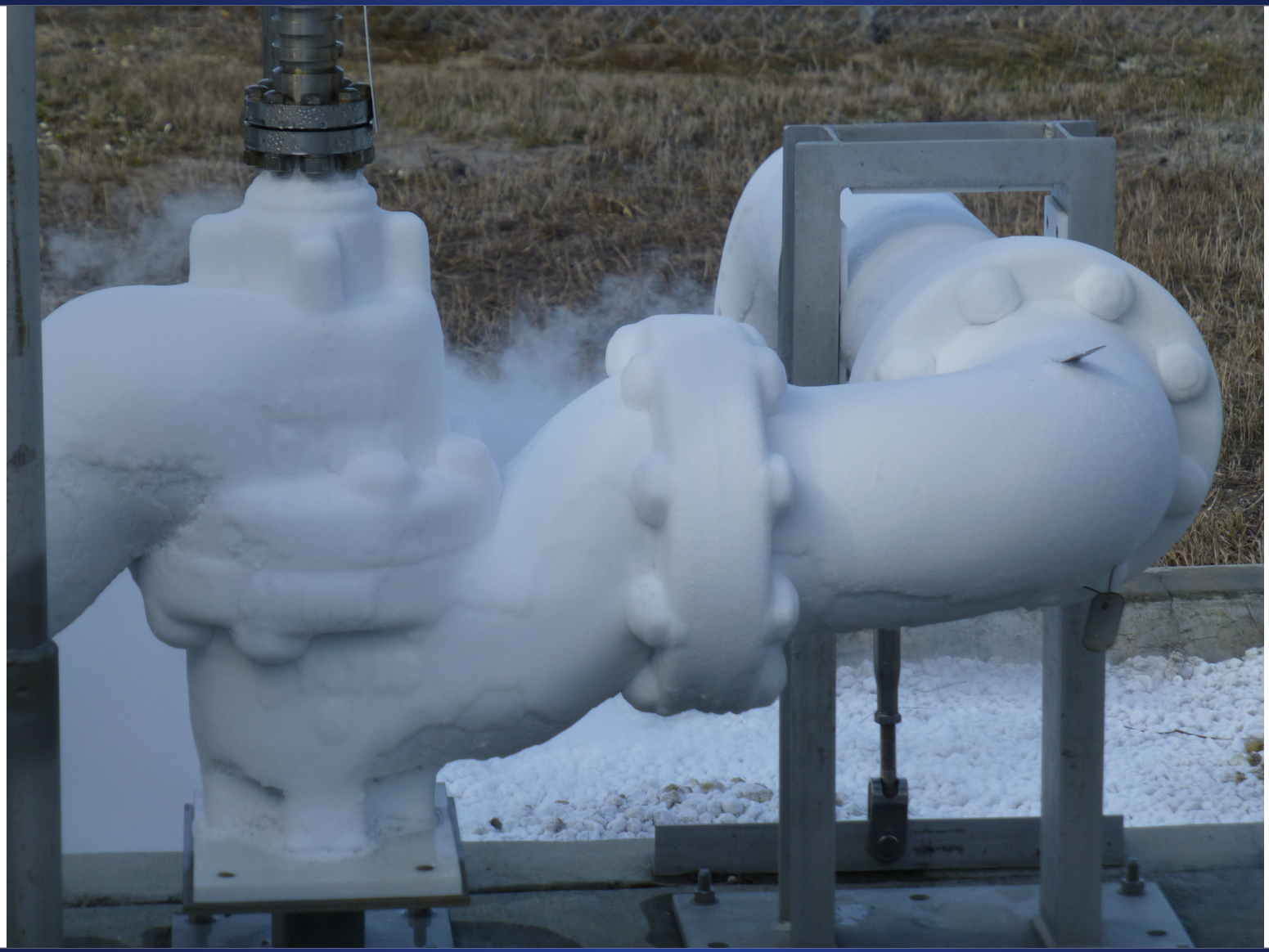
- Toolkit for developing ISHM and Control applications
- Libraries of objects and methods to develop domain maps (models), such as electrical, computing, mechanical, thermal, hydraulic
- Libraries of fault trees (using Symcure)
- Built-in real time and simulator engines
- Built-in monitor creation, plotting, analysis
- Built-in sequencer to command and control via OPC to devices like PLCs
- User Interface is multiple Telewindows NG

Application Example

- GA and NASA have jointly developed this toolkit originally at Stennis Space Center and currently used at the Kennedy Space Center in the Cryokgenic Testbed Laboratory
- This is a testing facility for rocket refueling, one goal is to improve upon Shuttle refueling operations
- Allen Bradley PLC controlling valves, pumps, sensors

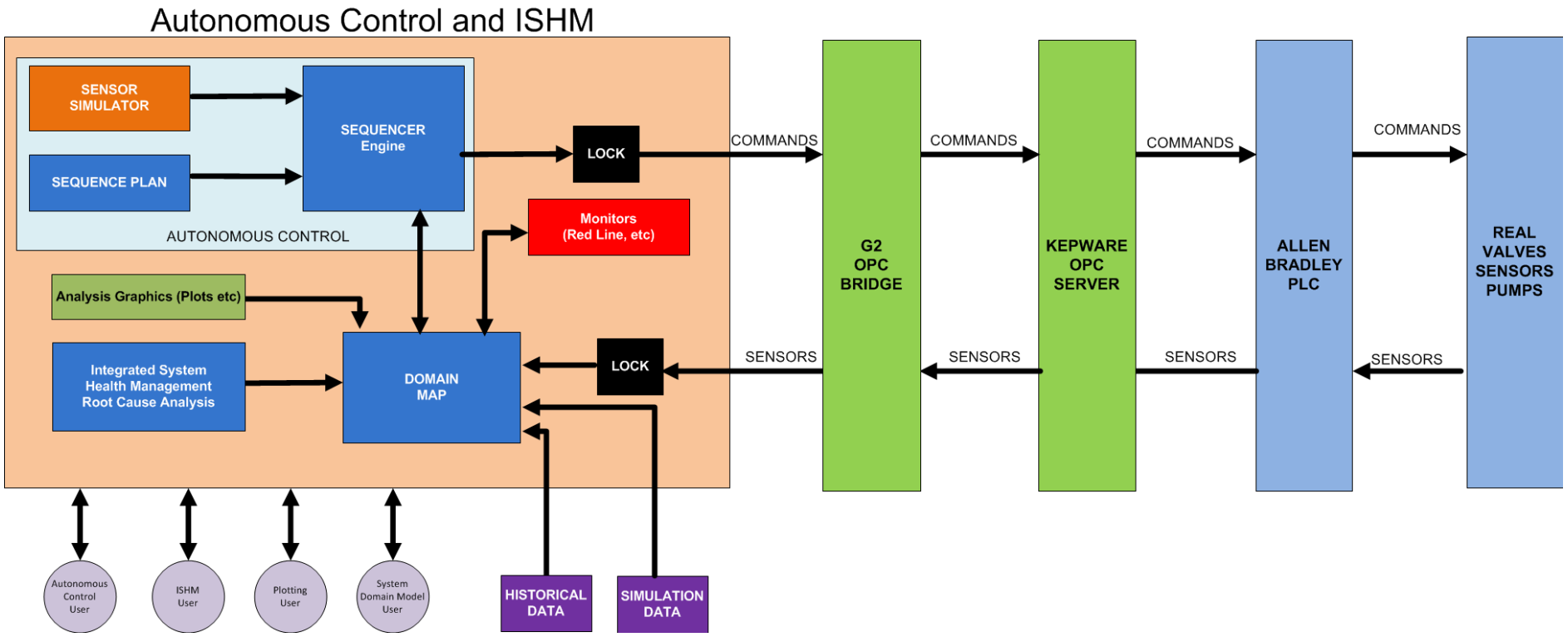
NASA Cryo Test Facility

What liquid Nitrogen does at -320 F



User Interface

Architecture



Operational Modes

REAL TIME

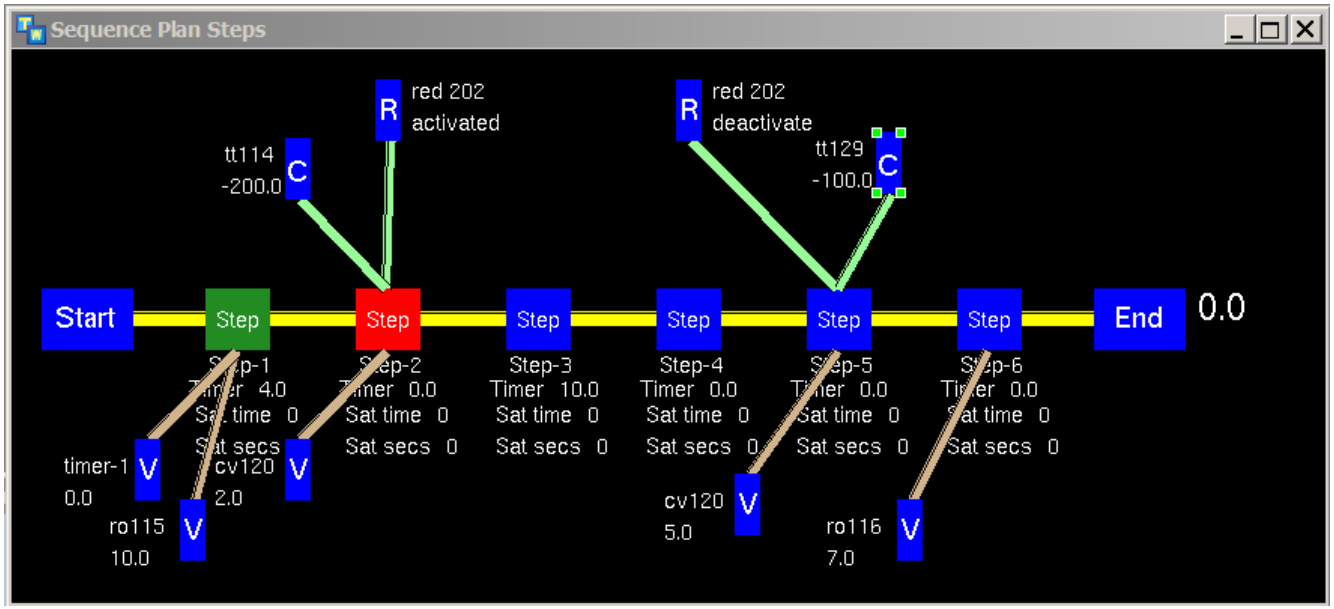
- System is designed in real time continuously
- Real time input data, monitoring with planned commanding and autonomous commanding as needed, manual commanding is also available

REPLAY

- Can run in Replay mode using historical data, commanding has a built-in simulator, speed of data can be controlled

Sequencer – Autonomous Commanding

- Sensor conditions, timers trigger next steps
- Command valves, pumps, cameras
- Red line conditions can trigger loading and execute shutdown or other plans



GENERAL ATOMICS
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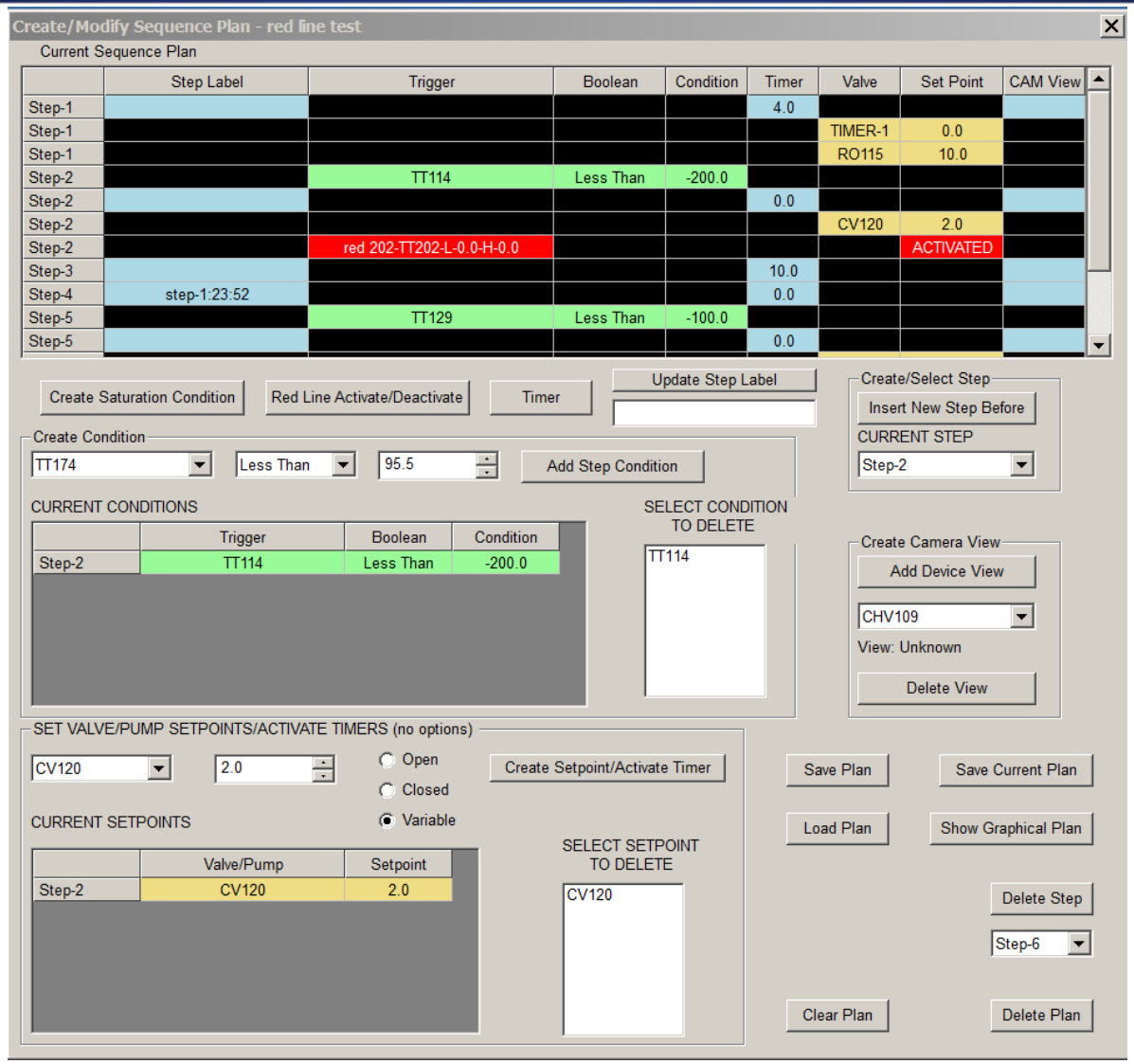
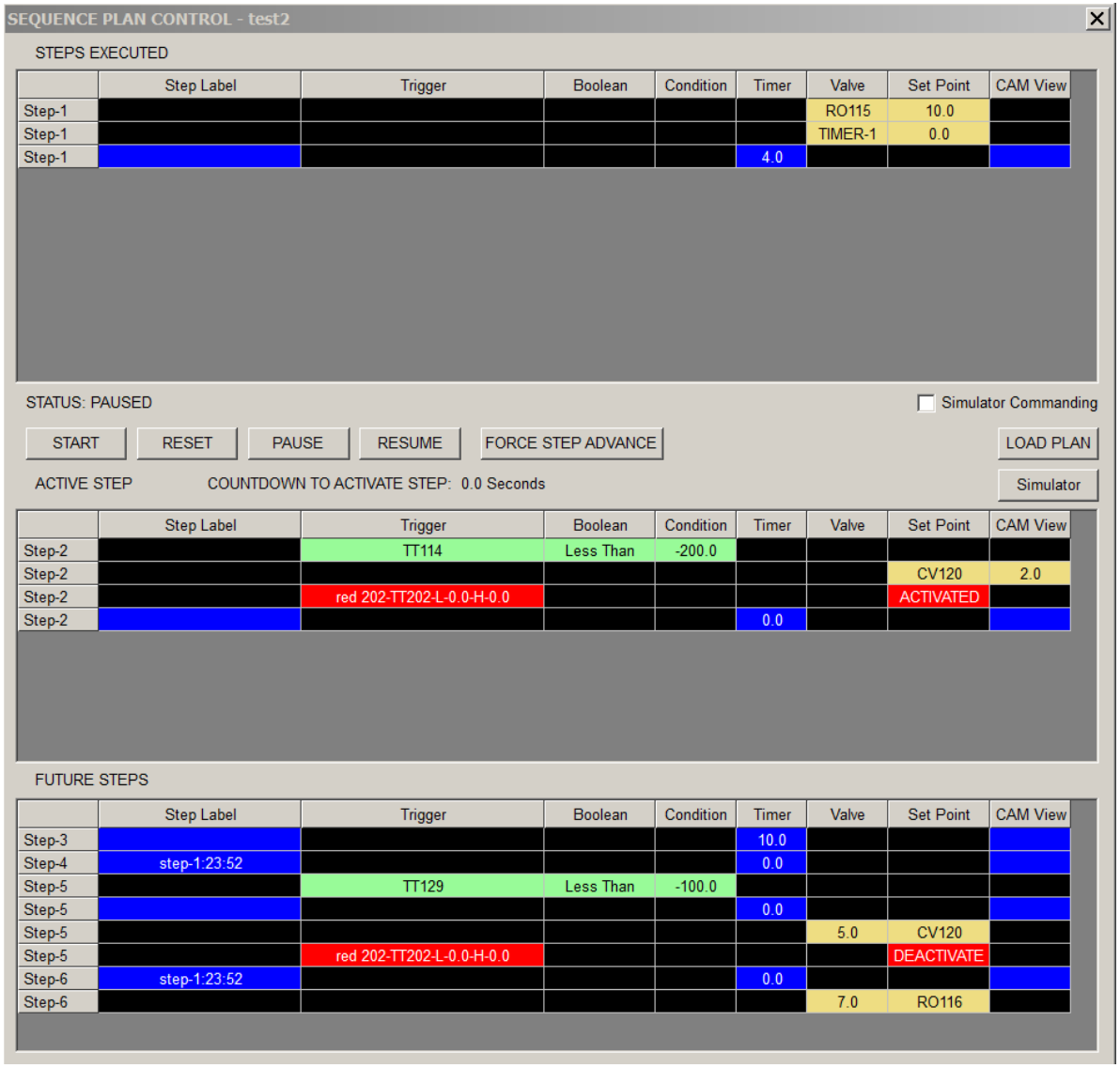
Create Plan

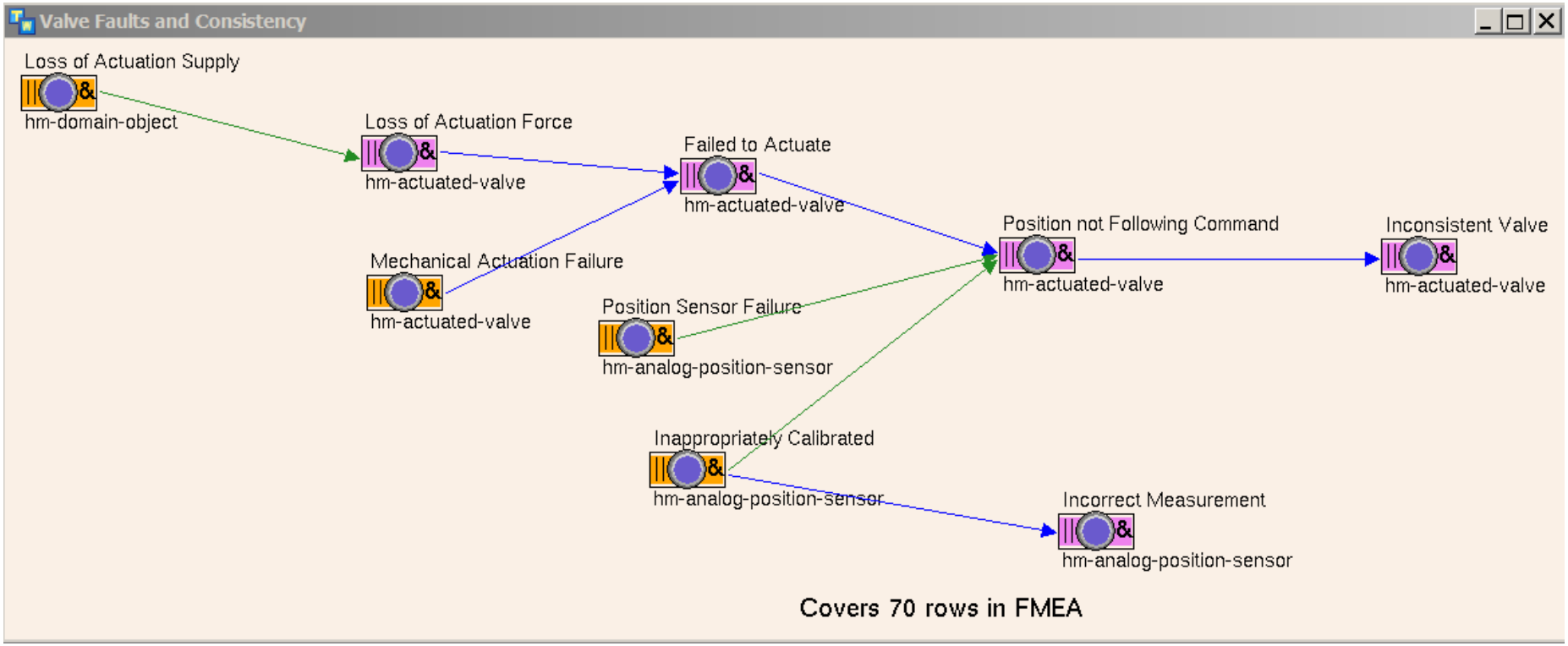

Create/Modify Sequence Plan - red line test
Current Sequence Plan
Step Label
Trigger
Boolean
Condition
Timer
Valve
Set Point
CAM View
Step-1 4.0
Step-1 TIMER-1 0.0
Step-1 RO115 10.0
Step-2 TT114 Less Than -200.0
Step-2 0.0
Step-2 CV120 2.0
Step-2 red 202-TT202-L-0.0-H-0.0 ACTIVATED
Step-3 10.0
Step-4 step-1:23:52 0.0
Step-5 TT129 Less Than -100.0
Step-5 0.0
Create Saturation Condition
Red Line Activate/Deactivate
Timer
Update Step Label
Create/Select Step
Insert New Step Before
CURRENT STEP
Step-2
Create Condition
TT174
Less Than
95.5
Add Step Condition
CURRENT CONDITIONS
Trigger
Boolean
Condition
Step-2 TT114 Less Than -200.0
SELECT CONDITION TO DELETE
TT114
Create Camera View
Add Device View
CHV109
View: Unknown
Delete View
SET VALVE/PUMP SETPOINTS/ACTIVATE TIMERS (no options)
CV120
2.0
Open
Closed
Variable
Create Setpoint/Activate Timer
CURRENT SETPOINTS
Valve/Pump
Setpoint
Step-2 CV120 2.0
SELECT SETPOINT TO DELETE
CV120
Save Plan
Save Current Plan
Load Plan
Show Graphical Plan
Delete Step
Step-6
Clear Plan
Delete Plan

Execute Plan

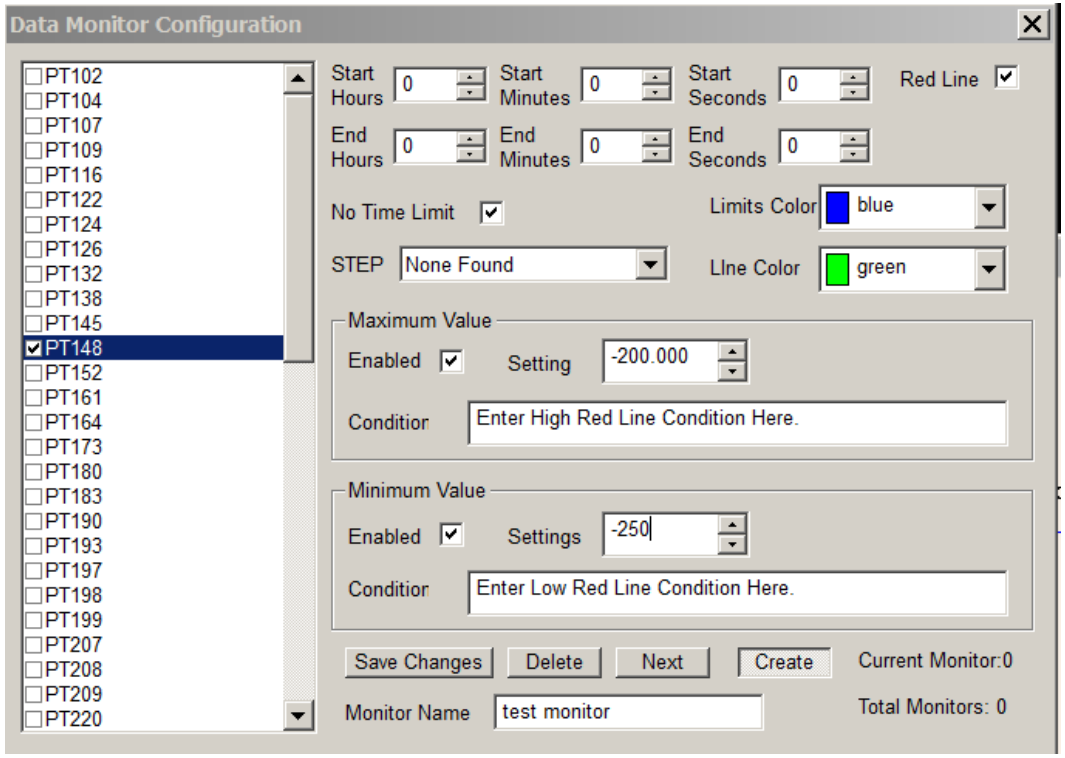


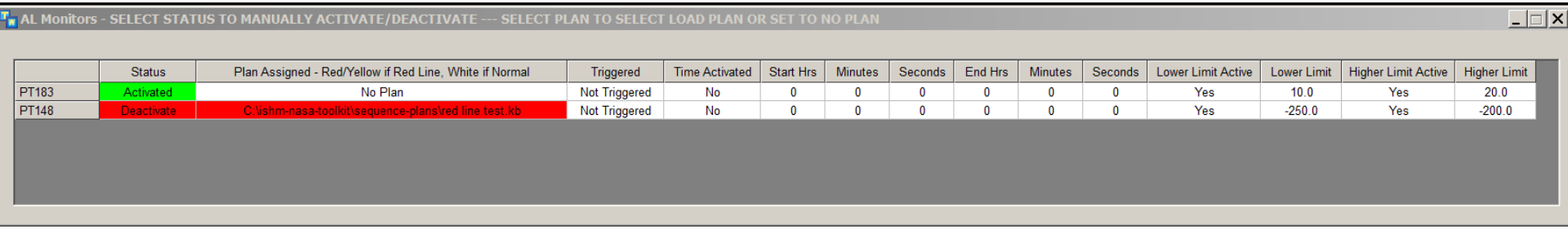
Fault Diagnosis

- We use Symcure Fault Trees to model the FMEA
- We have libraries of various fault trees



Monitors





	Status	Plan Assigned - Red/Yellow if Red Line, White if Normal	Triggered	Time Activated	Start Hrs	Minutes	Seconds	End Hrs	Minutes	Seconds	Lower Limit Active	Lower Limit	Higher Limit Active	Higher Limit
PT183	Activated	No Plan	Not Triggered	No	0	0	0	0	0	0	Yes	10.0	Yes	20.0
PT148	Deactivate	C:\ishm-nasa-toolkit\sequence-plans\red line test.kb	Not Triggered	No	0	0	0	0	0	0	Yes	-250.0	Yes	-200.0

Conclusions

- Our toolkit can be used to implement autonomy capabilities in different application areas
- Build a model of domain using built-in classes
- Adapt data handling to fit application area
- Select diagnosis fault trees needed and adapt/build any new ones missing
- Customize User Interfaces for application